DESCRIPTION

OF

A NEW AIR-PUMP.

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Read Feb. 23, 1818.

THERE is scarcely any instrument to which science has been more extensively indebted than the air-pump. From its invention to the present day, few important chemical discoveries have been made without its assistance, and it has in fact created the art of experimenting on invisible fluids. To the chemist therefore it is indispensable, it assists our operations on gasses, by it we are enabled to free in the most perfect manner the objects of analysis from moisture, and Leslie's beautiful experiments have given us a frigorific process practicable at all seasons, and susceptible of results which may be applied to various important purposes, even to those of domestic economy: by the help of this process the nicer and more delicate anatomical preparations are conveniently and expeditiously dried without being liable to the injury inseparable from their exposure to the united action of heat, air, and moisture.

Birds also, and the smaller animals may be thus preserved as specimens, without injury to their plumage or external appearance.

For many of these purposes a very imperfect instrument is sufficient, but it is in some instances requisite to abstract the air in a very high degree from our vessels. This great power of exhaustion has not yet been obtained without machinery, complicated, and therefore liable to derangement, and the high price of these more perfect instruments prevents many persons from availing themselves of them.

I have, on this account, ventured to lay before the Academy the description of an air-pump, which I think will be found to unite simplicity with great power of exhaustion, and which to all appearance is scarcely susceptible of being put out of order.

In Cuthbertson's pump there are three valves, two of which are opened mechanically, and of course are metallic, so that although in theory it is capable of exhausting indefinitely, yet if we consider how much the imperfections of workmanship, which are almost unavoidable in every air-pump, are increased by the complicated nature of his, and the excessive difficulty of its execution, it may be questioned whether in practice it is of as much value as it appears.

Prince's rejection of the receiver-valve is a great improvement, but the remainder of his apparatus is not equally elegant, and it may be shewn that his valve-pump does not extend its power very much independent of the complexity of such an addition. The instrument which I now describe resembles his, in the mode by which the receiver communicates with the barrel, but the valve which communicates with the atmosphere is opened mechanically. The apparatus for opening it cannot be attached to the piston, for

in that case there would always remain in the barrel a cylinder of air of the external density whose height would be the space through which the piston moved in closing the valve. It is therefore necessary that this should be closed *before* the piston moves from the bottom in the ascending part of the stroke. I have attained this object in a manner that will be easily understood by a reference to Fig. 3, which represents a front section of the pump, where A B is the barrel, C, the piston which is solid, D, a collar of leathers, through which the piston-rod passes, E, Fig. 2, a hole drilled through the barrel, aud communicating with the receiver by means of the pipe L, this hole is so placed, that when the piston is drawn up to the *top*, it just passes it by. F, the valve opening outwards, and having a projecting wire or tail to which the wire frame (G G) is attached. This valve is gently pressed up to its seat by a weak spring, and is covered by a cap (I) with holes in it for to let the air through. H, the rack which is moveable on the piston-rod, having a play of about $\frac{3}{4}$ of an inch between two knobs.

The action of the pump is as follows: when the piston is made to descend, it expels all the air that is in the barrel through the valve F, and when it nearly reaches the bottom, the end of the rack comes in contact with the upper cross-piece of the wire frame G G, and depresses it, by this means the valve is kept open until *after* the stroke is completed. The winch is now turned back, and before the rack can move the piston from the bottom, it (the rack) must move through the space between it and the upper knob, in doing which, the pressure is taken off the wire-frame, which now rises by the action of spiral springs concealed in the tubes M M. The piston is still at the bottom of the barrel, and they

being both accurately ground together, no air can possibly remain between them, so that each time the piston is drawn up, a vacuum is left behind it until it passes the receiver-hole, when a fresh portion of air must expand from the receiver into the barrel, this is expelled as before, and so the exhaustion must proceed without limit, at least as far as the expansive power of the air will permit.

I have not had time since the instrument was finished, to determine accurately its powers, but I know them to be considerable: When the valve is disengaged from its frame (and of course no longer opened mechanically) it still performs pretty well, bringing the mercury in the barometer gage to within $\frac{1}{5}$ of an inch of the barometric column, although the valve requires some force to open it against the pressure of the atmosphere; but in its ordinary condition, (attached to the frame) the difference is only $\frac{1}{20}$ of an inch, and on a dry day I have seen it less. Very few air-pumps exceed this, and even these do not without precations of manipulation, which, if used in the present instance, would encrease its power.

In one respect, only, I am not perfectly satisfied with it. In the ascending part of the stroke, the mercury sinks in the gage, and rises again as soon as the piston passes the hole, and these oscillations in some experiments may be inconvenient.

They are however only troublesome at the commencement of the exhaustion, diminishing with every stroke of the pump, and therefore do not produce any serious annoyance. But I have devised a means of preventing them, which is also useful on another account, as it makes the *up* as well as the downstroke, efficient in exhausting from the receiver, and the instrument becomes equivalent to a double barrelled pump. This improvement consists in

interposing between the pump and pipe leading to the receiver a piece figured at Fig. 4, in which is a conical piece of brass, (A) ground into a seat, and having a leather valve, (B) of the ordinary construction, opening towards the barrel. With this addition, it acts like a pump of the ordinary construction. Suppose the piston to be drawn up from the bottom of the barrel, the air *above* it cannot return into the receiver as before, it must be expelled through the parchment valve, (H) in the upper part of the pump, see Fig. 3 after the piston passes the hole, the space below it is filled from the receiver, and in its descent this portion of air is driven through the lower valve while the vacuum left above it is again filled from the receiver, and discharged as before through the upper valve: (H) at last the air in the receiver will be unable to open the valve which is interposed between it and the barrel. If more perfect exhaustion be required, the conical piece of brass (A) is now to be pushed out of its seat, which is effected by turning a wire that moves through a small collar of leathers, and which carries a pinion playing into the teeth of the little rack (D). It is obvious that the pump is now restored to its original form and the exhaustion must proceed sine limite as before.

It may be said that this produces complication, but if it does it doubles the rapidity of exhaustion, and in this respect may be compared to a pump, with a second barrel piston, &c. and there can be no doubt of its superior simplicity, besides it is of very easy execution, for the little collar of leathers is easily made, and always remains staunch,* and any accidental leakage of the valye

* As there is so little difficulty in making a collar of leathers, it may perhaps be worth considering whether one having a rod with a groove cut in half its length, might not be substituted for the stopcock of the air pump, which is always so difficult to be made and kept staunch.

is of no consequence, as it will be pumped out in the next stroke. The whole piece being connected with the receiver pipe and barrel by screws, can with ease be removed and examined. Indeed there is no part of the pump that cannot be readily got at, and in particular, the lower valve can be removed, cleaned, and replaced during the exhaustion.

By screwing on a pipe over the lower valve and connecting it with any vessel, we have a complete condensing apparatus, and if required, the air may be taken from the receiver, and transferred to any other vessel. Fig. 1. is a perspective view of the pump, with its barometer gage, &c. but it is obvious that it can be made of a much cheaper construction.

GEORGE KIERNAN.

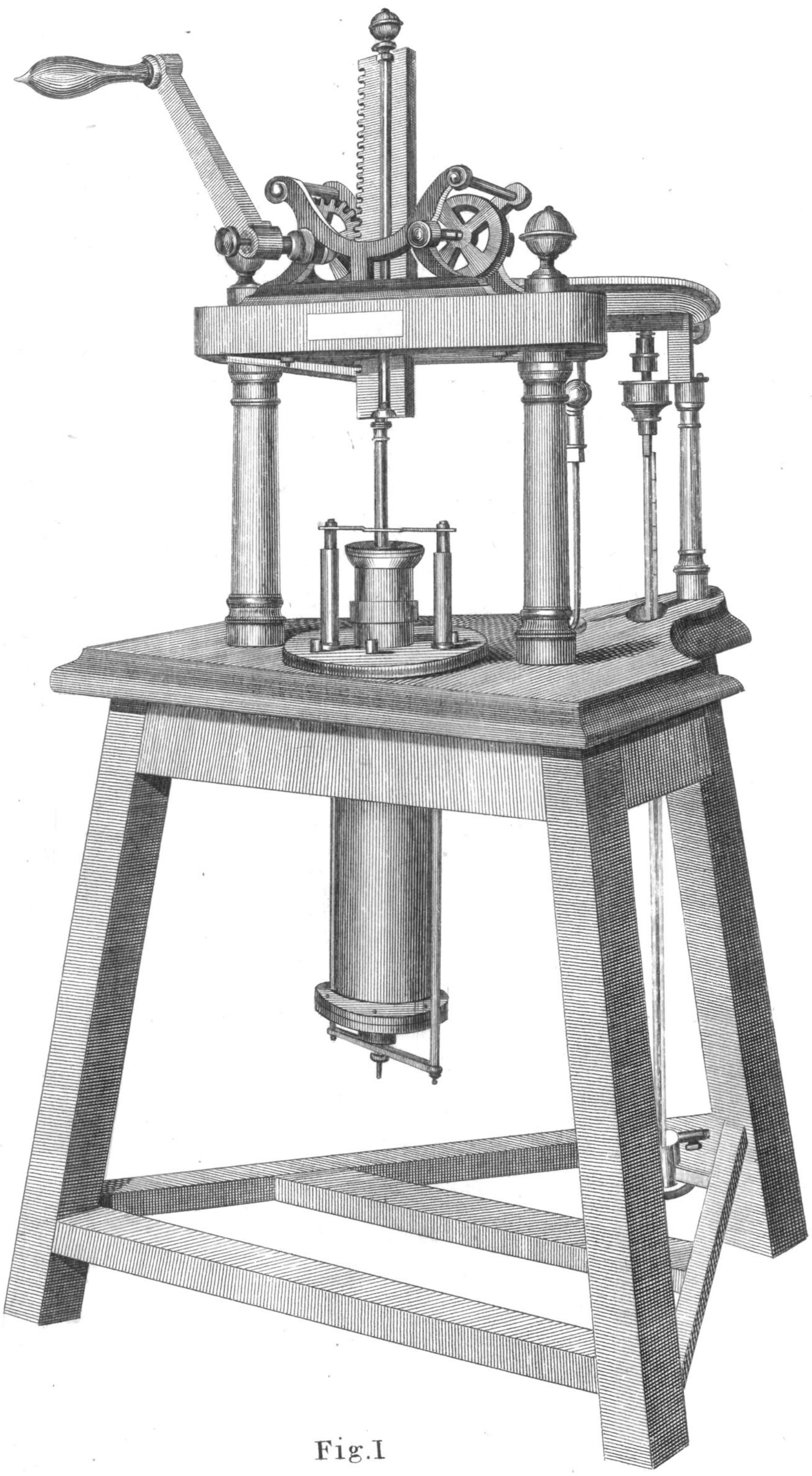

Fig. I

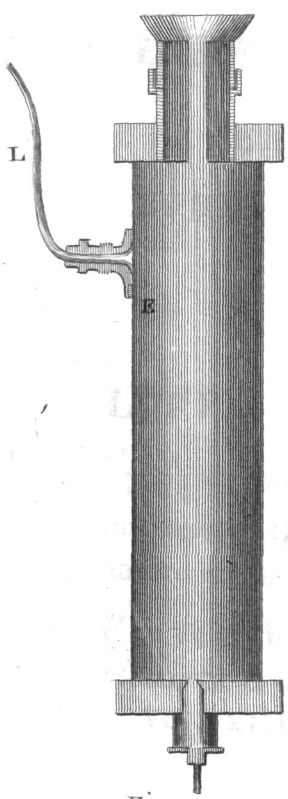

Fig.2

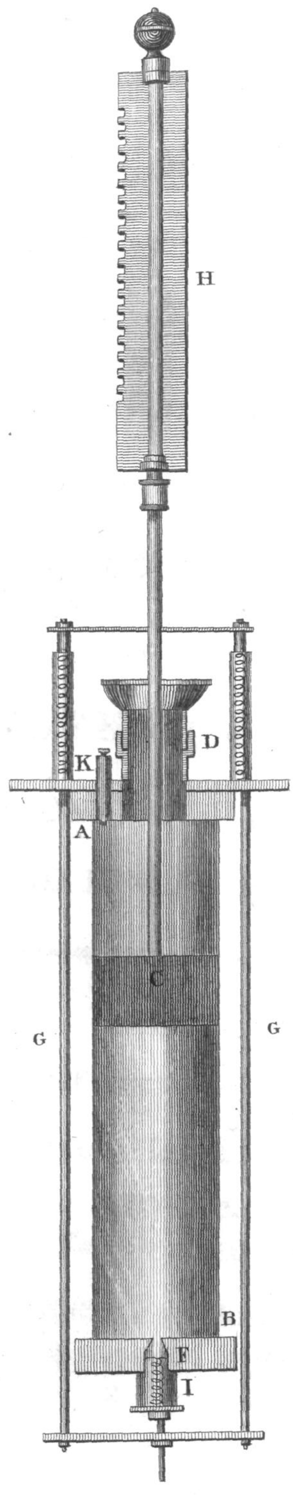

Fig.3

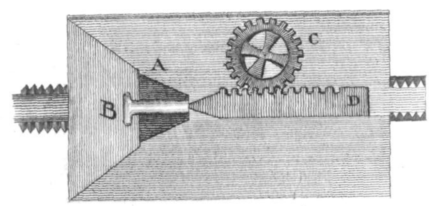

Fig.4